

Psyche Mission Concept Overview

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PSYCHE

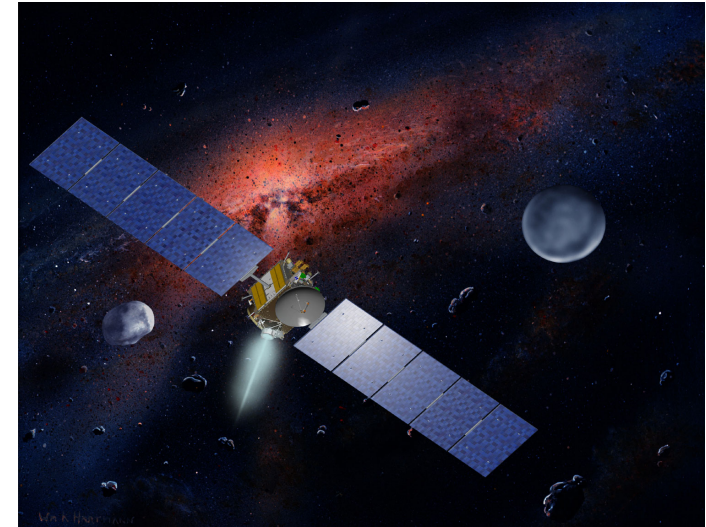
Predecisional information for planning and discussion only
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Discovery Program Overview



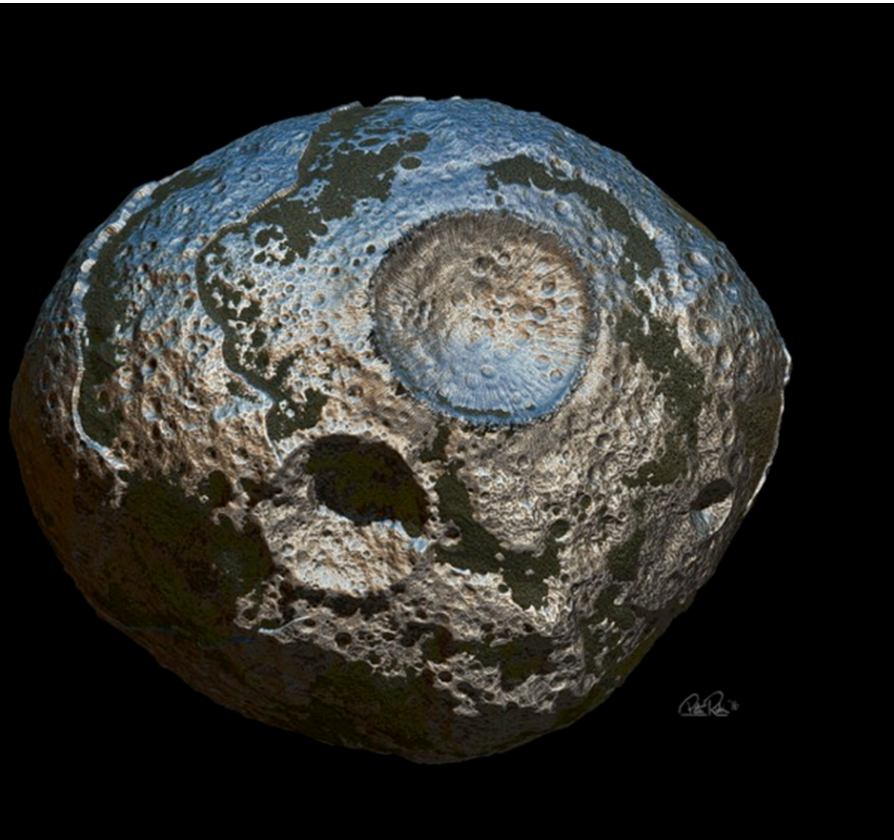
- Started in 1992
 - Principal Investigator (PI) Led
 - Science Missions
 - Cost Capped
 - Competed Proposals
- 13-14th Discovery Round announced February 2014
 - Step 1: 28 concepts submitted (early 2015)
 - Step 2: Downselected to five missions (late 2016)
- Two programs selected in January 2017 (Psyche, Lucy)



Dawn – Discovery Mission #9



Insight – Discovery Mission #12



Largest metal asteroid

Diameter ~200 km

High density

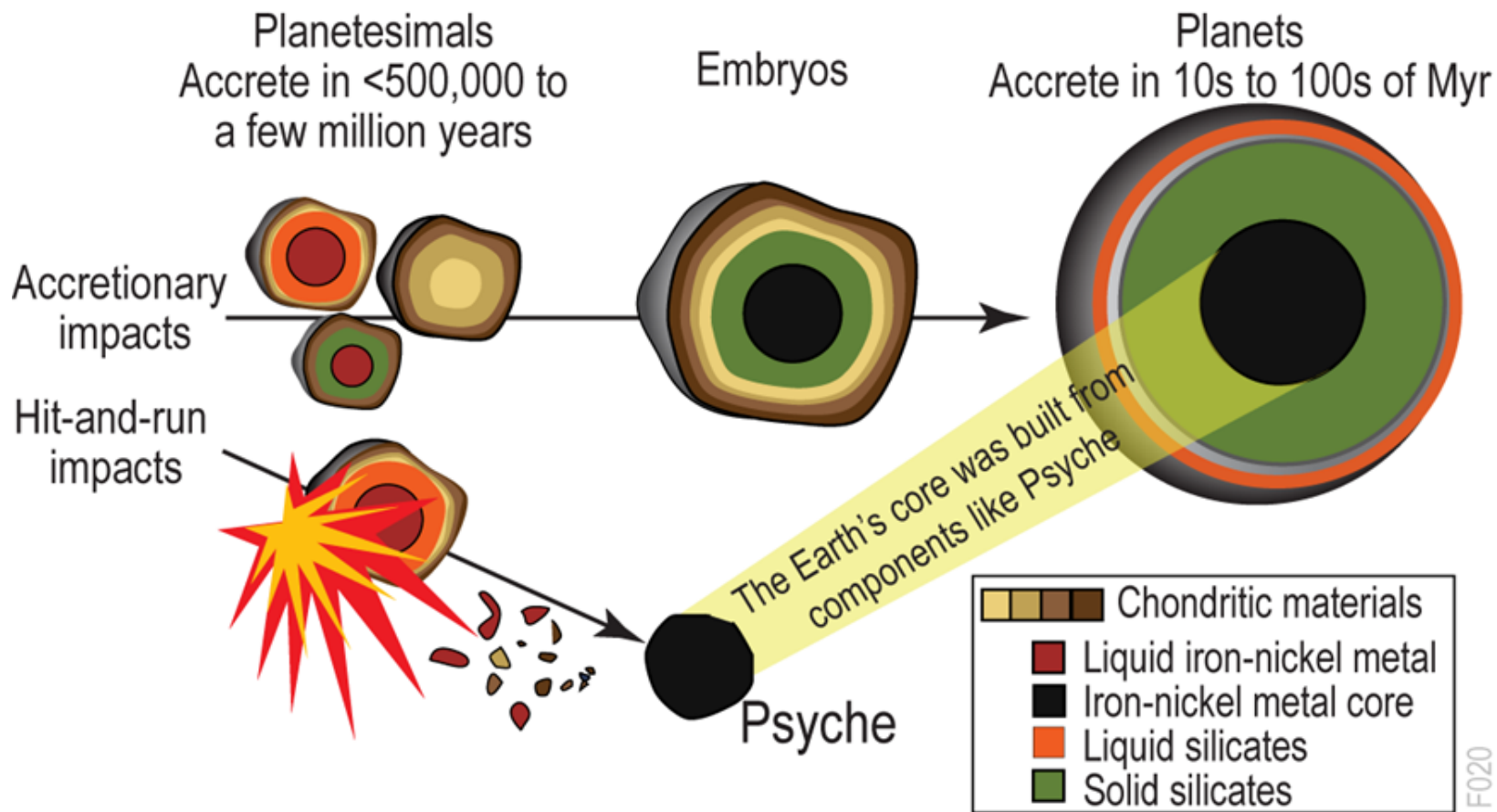
Spectra: 10% silicate, 90% metal

Radar shows the right albedo, high dielectric constant, high thermal inertia

Strong testable hypothesis:

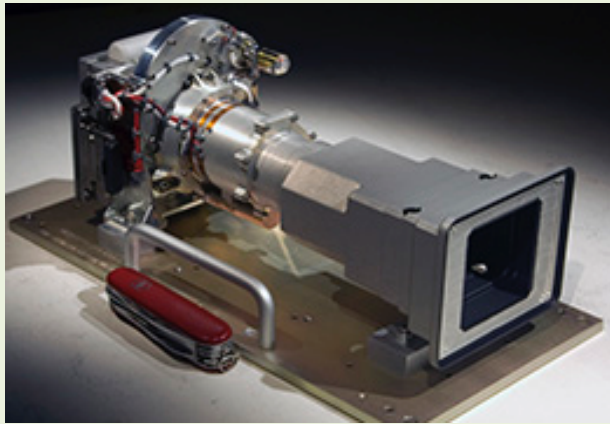
Is Psyche the exposed core of larger differentiated body?

Accretionary vs. Hit-and-Run Impacts





Proposed Science Payloads

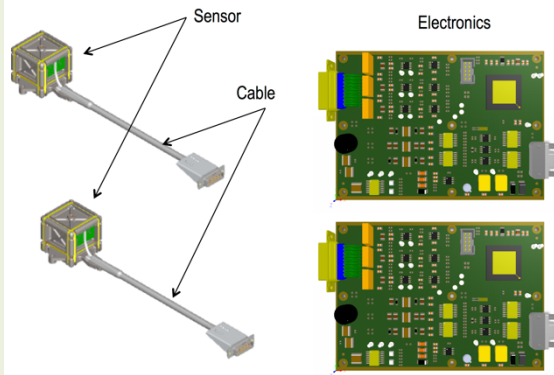
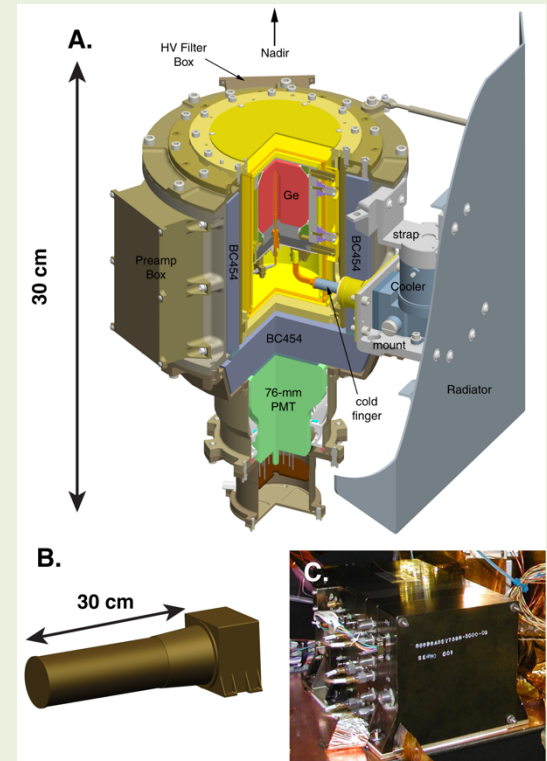


Multispectral Imager

- ASU lead/MSSS built
- Redundant units
- 5.9 kg total
- 8 filters
- 35 m/pixel highest orbit
- 5 m/pixel lowest orbit
- MSL Mastcam heritage

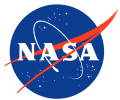
Gamma Ray and Neutron Spectrometer

- 12.1 kg, 2-m boom
- APL lead
- High Purity Ge detector
- He³ sensor (thermal neutrons)
- MESSENGER heritage

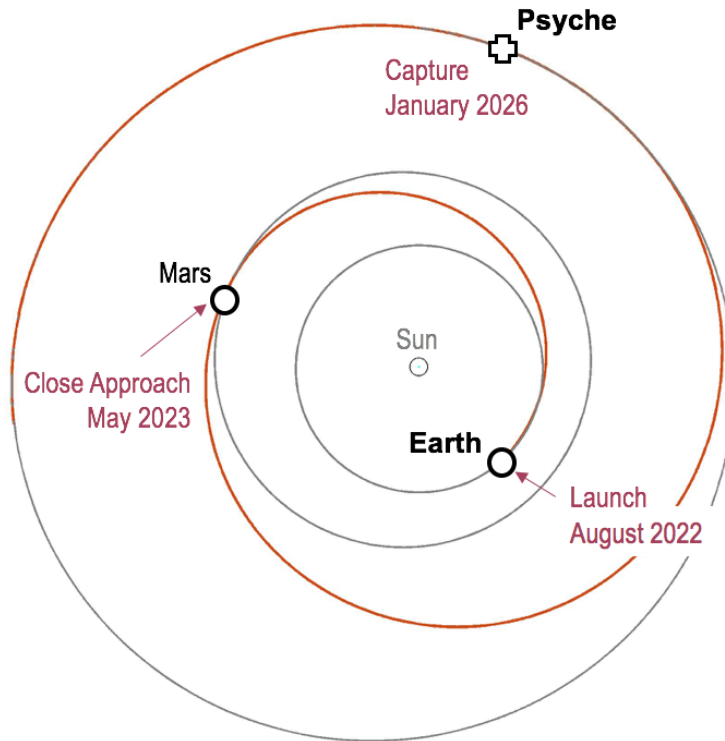


Magnetometer

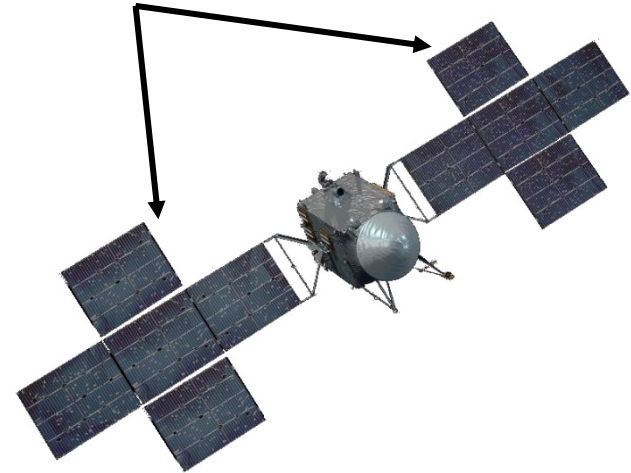
- MIT lead/UCLA built
- 2 sensors
- 1.5 kg total
- 2-m boom (gradiometer)
- 0.2 – 100,000 nT range
- MMS, Insight heritage



2022 Projected Mission Timeline



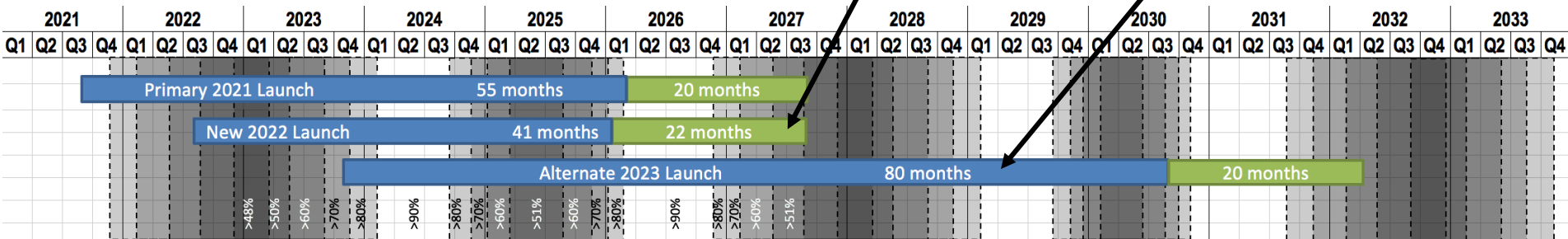
Five panel solar arrays
~21 kW BOL



Today's Baseline:
2022 with Five Panel array

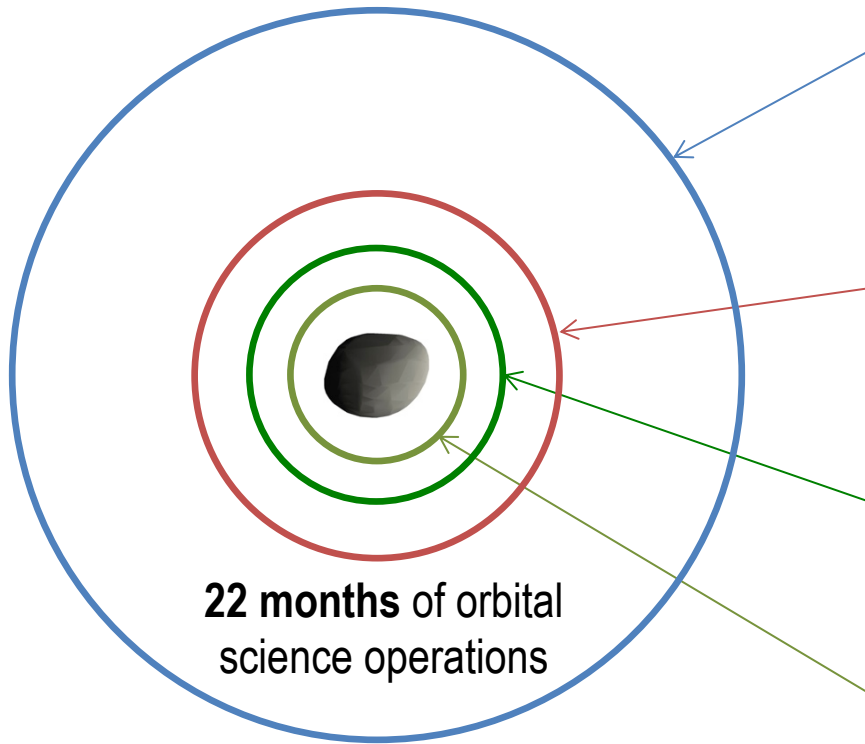
As Originally Selected
2023 with Four Panel (17 kW) array

Cruise: 3.4 years





Science Operations Concept



Orbit A: 40 days (29 orbits @32.4 hrs, ~700 km alt)
Magnetic field detection requirements complete

Orbit B: 50 days (107 orbits @11.2 hrs, ~290 km alt)
Topography requirements complete
Spectral Imaging requirements complete

Orbit C: 100 days (369 orbits @6.5 hrs, ~170 km alt)
Gravity requirements complete

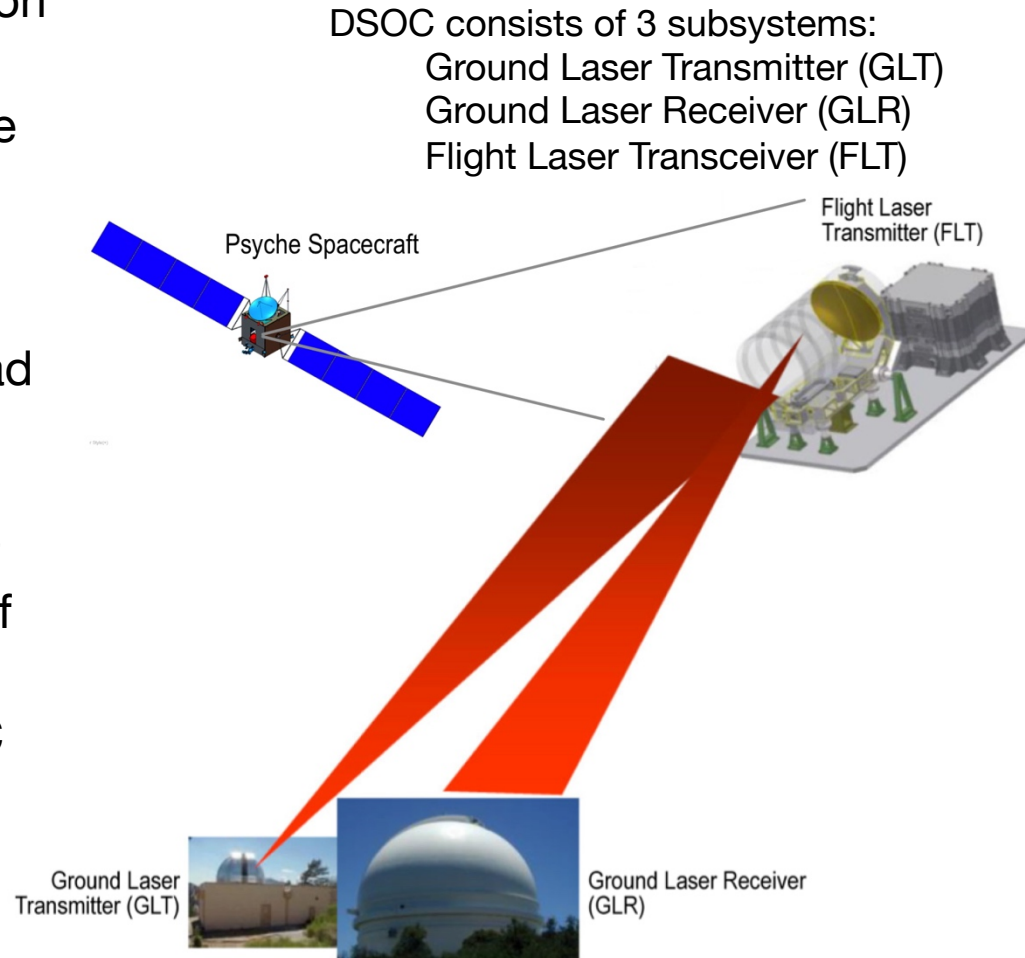
Orbit D: 100 days (585 orbits @4.1 hrs, ~85 km alt)
Elemental **composition** requirements complete

Science Operations Similar to Dawn Mission Profile

Deep Space Optical Communications Concept



- DSOC is a technology demonstration provided as GFE to Psyche
- Flight Laser Transmitter (FLT) will be mounted on the Psyche spacecraft and pointed at Earth for DSOC operations
- Psyche will treat DSOC as a payload element, not a required flight uplink/downlink path
- DSOC operations are planned for 2 hours per month, during portions of Cruise Phase
- Psyche coordinates with the DSOC project for development and implementation

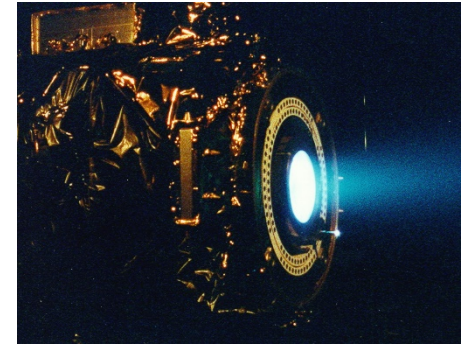




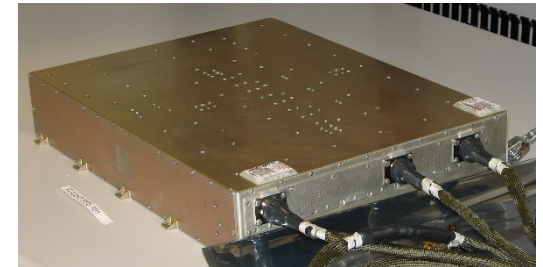
Dawn: Enabled by NSTAR/DS-1 Technology



Proposed 2001, Launched 2007



NSTAR Ion Thruster



NSTAR PPU

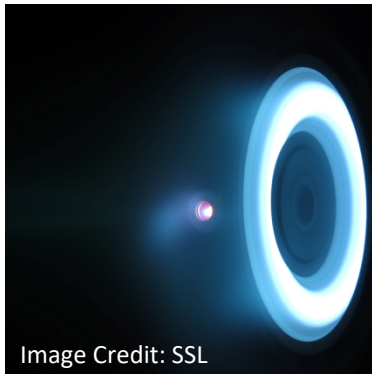
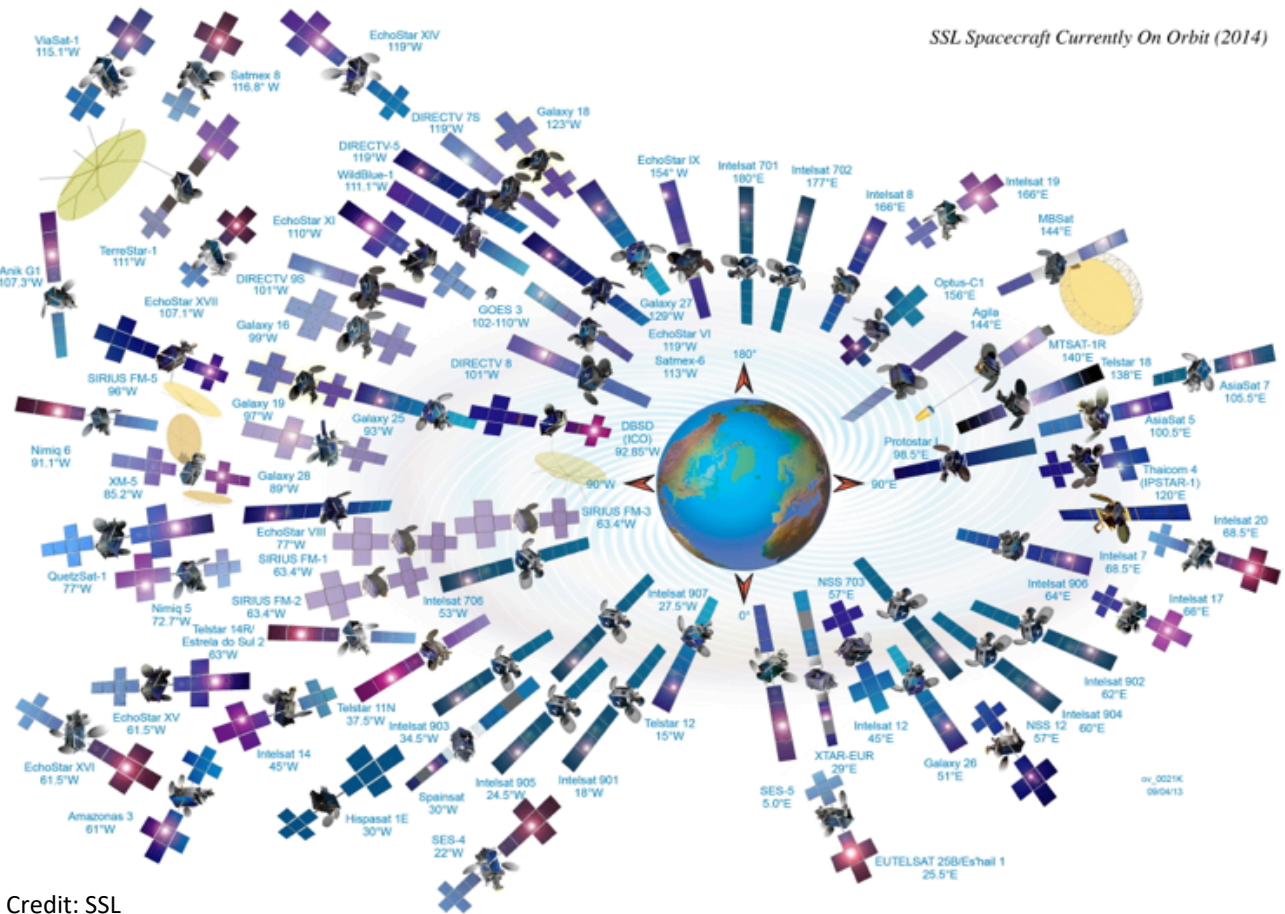


Image Credit: SSL

SPT-140 Hall Thruster



- 29 Electric Propulsion (SPT-100) flights to date...
- Over 100 SSL 1300 spacecraft launched
- Over 14 high power (> 20 kW) spacecraft on orbit

Can we adapt GEO Electric Propulsion *spacecraft* to Deep Space?

Similarities...



Launch



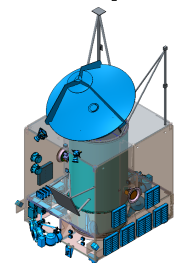
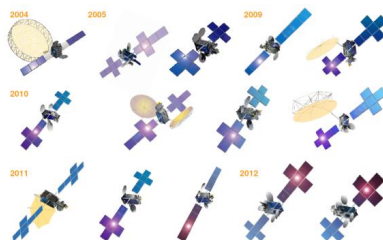
High Power



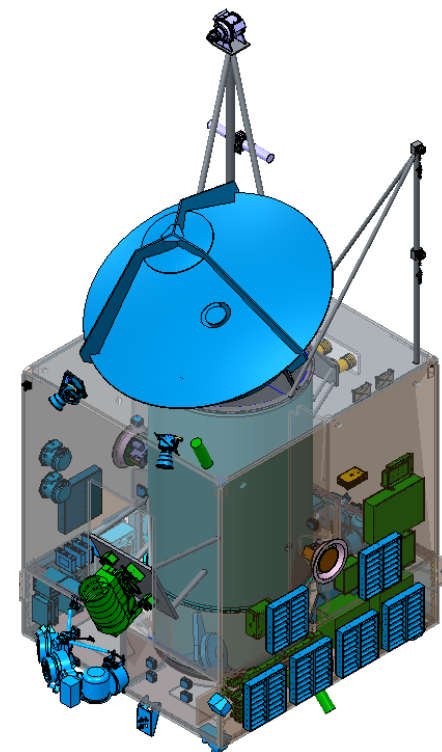
Electric Propulsion

High Reliability, Long Lifetime

- Composite Structure
- High Power
- Electric Propulsion

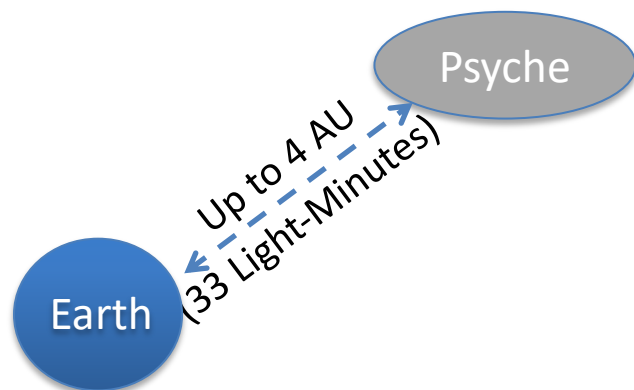


SSL
SEP Chassis



Psyche

Differences....



Distance = Autonomy

- Autonomous Ops & Fault Protection



JPL Flight Software
and C&DH

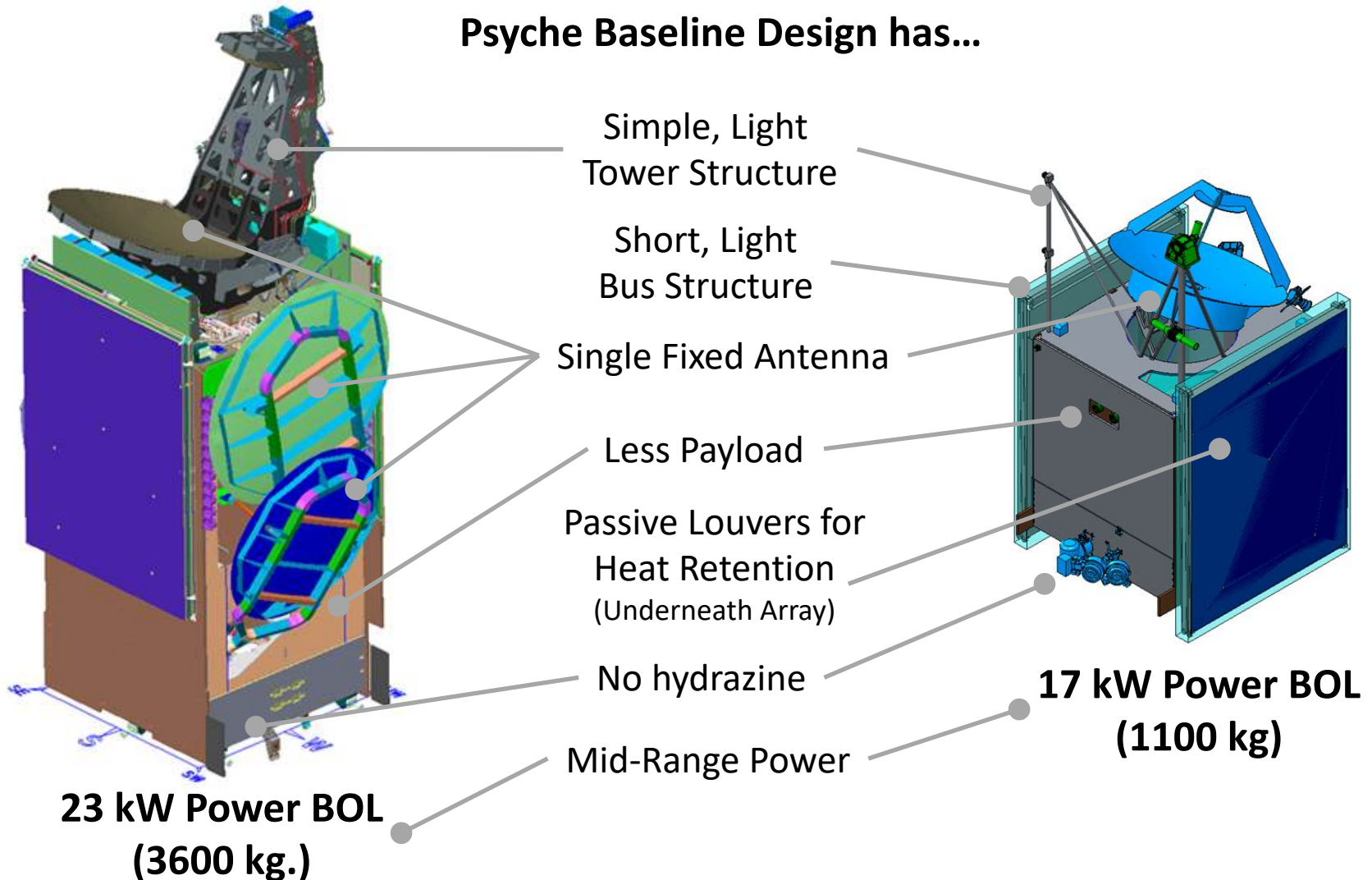
Psyche Baseline Design vs. SSL GEO Comsat



SSL High Power GEO Spacecraft

Psyche Baseline Design

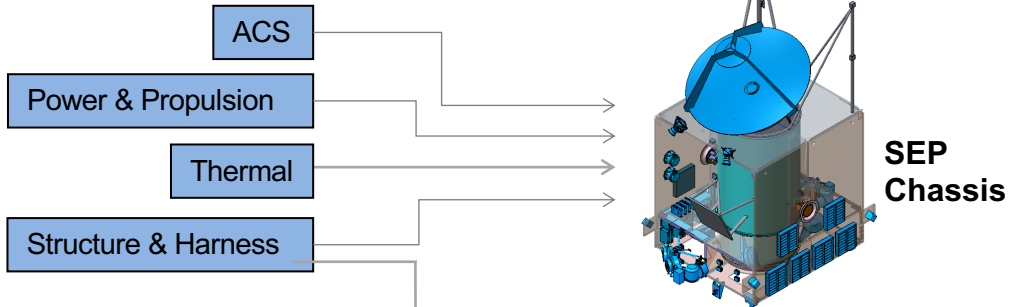
Psyche Baseline Design has...



JPL-SSL: A Complementary Partnership

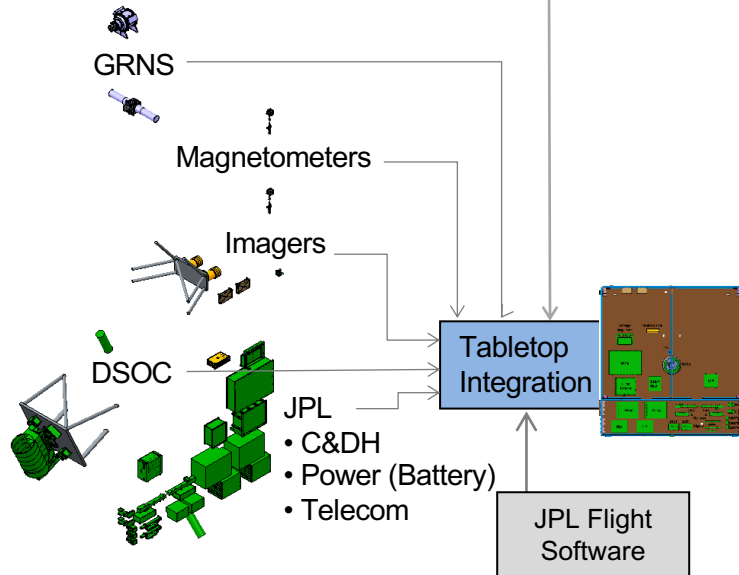


SSL (Palo Alto)

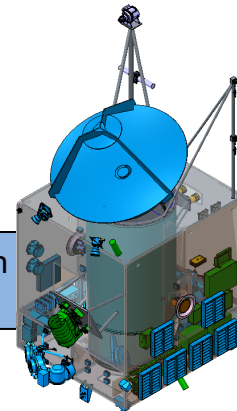


Flight-like Harness & Integration Panel

JPL (Pasadena)



Integration and Test



Environmental Testing

Ship & Launch

Responsibility	Organization
Flight System C&DH Hardware Fault Protection Flight Software GN&C Software Power (Battery Bus) Telecom	JPL
SEP Chassis ADCS Hardware Propulsion Power (SEP Chassis) Structure Thermal	SSL
System Engineering	JPL
Assembly, Integration, Test	JPL

Palo Alto
Pasadena

Questions?



Asteroid: Peter Rubin/Caltech-JPL
Spacecraft: SSL